Third United Nations International Conference on the Peaceful Uses of Atomic Energy

A/CONF.28/A/472
GERMANY, FEDERAL REPUBLIC OF
February 1964
Original: ENGLISH

Confidential until official release during Conference

Abstract

Fission Gas Release from Solids with Special Regard to UO_2, UC, and ThO_2 Single Crystals*

by

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Neutron irradiation of special solids results in single atoms of rare-gases dispersed in the solid system. By observing the kinetics of the diffusion and final release of the rare-gas stoms, structural and chemical changes during thermal treatment of the solid can be observed and investigated (Zimen [1]). In fissionable solid materials and at higher burn-up the formation of rare-gas atoms and bubbles implies a mechanical stress of the fuel elements and jackets, and a change of reactivity by the build-up of Xe-135. To study the mechanisms of rare-gas diffusion in and the release from solids the following investigations were conducted:

1. Theoretical studies of the kinetics of ideal rare-gas diffusion in case of post-activation diffusion (PAD) experiments (Inthoff, Zimen [2] , Gaus [3]) and in case of dum-activation diffusion (DAD) or in-pile experiments (Flügge, Zimen [4] , Gaus [5]).
2. Development of proper methods for the evaluation of PAD and DAD measurements in case of ideal and non-ideal gas release (Zimen [6] , Lagerwall, Zimen [7] , Lagerwall, Schmeling [8]).

* A large part of the work referredto in this survey was accomplished under EURATOM contract in the framework of the JOINT EURATOM/UNITED STATES PROGRAM.

3. Development of experimental techniques for PAD experiments with corrosion-sensitive materials at high temperatures (Schmeling, Felix [9], Felix, Schmeling, Zimen [10]).

4. Experimental investigations with model systems. Up to now results have been obtained for Argon diffusion in single crystals and poly-crystalline material of CaF_2 (Lagerwall [11] , KF and KCl (Richter, cf. [10]).

   In silver samples containing small amounts of Li the simultaneous diffusion of H-3 and He could be investigated and interesting differences in the behaviour of the two gases were observed (Migge, Wagener, [12]).

5. Experimental investigations with fuel materials. The results hitherto obtained are concerned with UC in graphite matrix (Schmeling [13]) and with single crystals and polycrystalline material of UO_2, UC, and ThO_2 (cf. [10]). The unpublished results concerning these systems will be described in the report.

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